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National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
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DEC 23 2014

Michelle Morin
Chief, Environment Branch for Renewable Energy
U.S. Department of the Interior
Bureau of Ocean Energy Management
Washington, D.C. 20240-0001

Re: Cape Wind Energy Project, Request for Concurrence in Finding of Not Likely to Adversely Affect for the Atlantic Sturgeon

Dear Ms. Morin,

In response to your September 9, 2014 letter, we concur with the Bureau of Ocean Energy Management's (BOEM) determination that the construction, operation and decommissioning of the Cape Wind Energy Facility is not likely to adversely affect the Atlantic sturgeon.

Atlantic Sturgeon Listing

As you know, on October 6, 2010, we issued proposed rules to list five Distinct Population Segments of Atlantic sturgeon as threatened (Gulf of Maine DPS) and endangered (New York Bight, Chesapeake Bay, Carolina and South Atlantic). Final listing rules were published on February 16, 2012 (77 FR 5880 and 5914).

The December 30, 2010 Biological Opinion (Opinion) that we previously issued on the Cape Wind project pursuant to section 7 of the Endangered Species Act (ESA) of 1973, as amended, did not consider potential effects on the Atlantic sturgeon because the listing of that species had not been finalized and become effective at the time consultation was completed.

As we explain below, we have determined that any effects of the Cape Wind project on the Atlantic sturgeon will be insignificant and/or discountable. Therefore, we concur with your determination that BOEM's proposed action is not likely to adversely affect the Atlantic sturgeon. No incidental take of Atlantic sturgeon from any DPS is anticipated. Because BOEM's proposed action is not likely to adversely affect the sturgeon, it is not necessary for us to produce a new Biological Opinion to incorporate these conclusions. 50 CFR 402.14(b).

As of the date of this consultation, certain portions of the project already have been completed (*i.e.*, pre-construction geotechnical and geophysical surveys). As such, we consider here potential impacts from the planned construction, operation and decommissioning of the wind turbines, associated electrical cables and platform, as well as vessel traffic, as recently amended.



The Proposed Action, As Amended

A complete description of the proposed action is included in the 2010 Opinion. We incorporate that description by reference. On July 25, 2014, Cape Wind Associates (CWA) filed a Facilities Design Report and Fabrication and Installation Report (FDR/FIR) and revised Construction and Operations Plan (COP) with the Bureau of Ocean Energy Management (BOEM). With the exception of what is described below, the proposed action remains as it was described in the December 30, 2010 Opinion.

Timing of Construction

In the 2010 Opinion, we stated that construction was planned to take place over a 5-9 month period between April and November, the full period of which would result in construction occurring over two seasons. CWA has provided BOEM with additional details on the construction schedule that clarify when different activities will take place. In the July 2014 COP, CWA states that the monopiles to support 101 turbines would be installed during the first season of construction ("Season A", currently scheduled to occur between April and August 2015). During the second season, the remaining 29 monopiles will be installed ("Season B", commencing after April 2016). Installation of scour protection will follow monopile installation in the same year. Intra-array cable installation would also occur in the same year as monopile installation. Submarine cable installation (connection to shore) would occur in the second construction season (2016). In-water construction work for the Electrical Service Platform (ESP) is currently scheduled for the first season with topside work scheduled for the second season.

Inner-Array Cable Route

CWA has made minor modifications to the inner array cable routing. In addition, the total length of the cable route is increased to 70 miles from 66.7 miles, an increase of approximately 3.3 miles. The inner array cable route is illustrated in Figure 1. As illustrated in Figure 1, cable installation will occur in two construction seasons.

Electrical Service Platform Design

The ESP's fixed template-type jacket frame foundation system has been revised from the originally proposed single, large, jacket frame anchored with six driven foundation piles to an updated design that requires two smaller, separate, jacket frames, each anchored with four driven foundation piles (for a total of eight piles). The diameter of the piles (approximately 42") remains unchanged. The COP (p. 84) describes the installation of the ESP jackets as follows: "The jacket will be transported to the site on a jack up transport barge. Once on site, the jacket is expected to be lifted from the transport barge by a crane mounted on a separate jack up barge." The jackets will be installed from a floating barge rather than a jack up barge. The topside installation procedure is a float-over and remains as described in the COP.

The dimensions of the ESP have also changed. The ESP will be smaller (132' x 115' (15,180 square feet); compared to 100' x 200' (20,000 square feet) as originally planned) and will not rise as far off the water. The first deck will be approximately 35' above MLLW and rise 47' to the roof compared to the original design of the first deck of the ESP to be approximately 39' above MLLW and rising 49' to the roof. CWA is also planning to install three rather than four

transformers at the ESP, with a total of 30,000 gallons of transformer cooling oil (compared to 40,000 gallons originally considered).

Pile Installation

In their FDR/FIR, CWA describes the types of impact hammers to be used for pile driving during the installation of turbine foundations and ESP jacket foundations. CWA plans to use an IHC S-1800 hydrohammer, a Menck 1900S impact hammer or an equivalent hydraulic impact hammer with a comparable energy rating to drive the piles to grade.

BOEM will require CWA to employ a noise attenuation system (NAS) during pile driving operations to ensure that: the radius of the 180 dB re 1uPa peak isopleth does not extend beyond 750 m; the radius of the 160 dB re 1uPa RMS isopleth does not extend beyond 3.4 km during impact pile driving; and, the radius of the 120 dB re 1uPa RMS isopleth does not extend beyond 3.4 km during vibratory pile driving. CWA is proposing to use a large bubble curtain system as a noise attenuation system (NAS) for all pile driving. Sound source verification will be required for the first pile installed with the impact hammer and the first time a vibratory hammer (see below) is used. While unexpected, if the size of these isopleths is greater than these distances, BOEM will require CWA to employ additional mitigations that are effective in achieving the required reductions. BOEM confirms that should an additional sound barrier be needed, the bubble curtain system has the inherent flexibility to accommodate this requirement; that is, it is possible to add a second layer of bubbles.

BOEM estimates that while specific actual installations will vary in performance, a single bubble curtain is predicted to reduce noise levels by 8-14 dB (peak). This prediction is considered to be an effective quantification of relative performance to evaluate pile installations (Stokes *et al.*, 2010). A report published by the German Federal Agency for Nature Conservation (2013) documents that reductions of 8-14 dB (peak) were achieved with the single ring bubble curtain in water depths from 23-33 m.

The bubble curtains act as a direct reduction of the source level. Assuming standard $20 \log(R)$ spherical spreading (as described in BOEM's effects analysis this is a reasonable assumption considering the relatively shallow depths and short distances being discussed), a single bubble ring will result in noise levels as described in Table 1.

Boulder Mitigation

Geotechnical and geophysical investigations on the Project Site have confirmed that the site is potentially populated with a variety of large glacial erratics (boulders) on the surface of and in the top 10 m of the soil matrix. In the event that a boulder is encountered during the installation of a monopile, CWA has proposed the use of four possible methodologies to mitigate for boulders: driving through a boulder with the impact hammer, use of a vibratory hammer, clamshell extraction or drilling through the boulder.

Driving through a boulder with the impact hammer

Foundation monopiles are designed to be driven to full penetration with a hydraulic impact hammer. If a boulder is encountered during driving, the selected hammer may drive through the boulder. According to BOEM, this has been successfully done on European projects.

Vibratory hammer

Test installations have been done using vibratory hammers on European offshore wind projects (de Neef *et al.*, 2013) and more are in progress (RWE Innogy, 2014). BOEM states that fatigue analysis has shown that using the vibratory hammer is within the foundation design standards and will allow multiple attempts of re-driving the pile. A pile that is partially driven and blocked by a boulder could be extracted by the vibratory hammer and moved to a new location. Further engineering analysis is underway to confirm the suitability of this option. If a vibratory hammer is chosen as the preferred boulder mitigation method, CWA will use the Cape Holland Super Triple Kong vibratory hammer system. The Super Triple Kong is comprised of three APE 600 vibratory driver/extractors.

Clamshell extraction

Given the large diameter of the monopiles, it may be possible to extract the boulder from inside the monopile with a clamshell dredge. This is potentially the fastest method, but its effectiveness depends on site-specific conditions.

Drilling

A drill that fits closely inside the monopile could be lowered to the soil plug present at approximately the seabed elevation. As the drill is rotated and advanced to the boulder, a reverse circulation (airlift) process will be used to remove the cuttings in a controlled manner through the center drill pipe. Driven by the water pressure and the rapid expansion of the injected air, an air-water mixture will quickly flow upwards in the drill pipe, pulling the drill cuttings along with the flow. The cross-flow of water from the drill annulus below the full-face bit will carry drill cuttings to the center pipe and subsequently to the surface for disposal by appropriate means. It may be necessary to deploy under-reaming bits to clear the boulder from below the pile tip, and once the obstruction has been passed, the drill will be retracted and the monopile will be advanced again by a hydraulic or vibratory hammer.

Table 1: Sound source levels for equipment to be used during Cape Wind construction operations (provided by BOEM)

Noise Source	Peak (1m)	Radius of isopleth: 206 dB re 1 μ Pa PEAK (m)	Radius of isopleth: 187 dB 1 μ Pa ² s cSEL (m)	Radius of isopleth: 150 dB re 1 μ PA RMS (m)
Unabated Impact Hammer	241 dB	215	20,702	464,159
Impact Hammers with single bubble curtain (20 log r transmission loss)	233-227 dB	22	795	2,512
Vibratory Hammer	220 dB	<10m	--	<750m
Clamshell Dredge	163 dB	--	--	<50m
Drill	127 dB	--	--	--

Scour Protection

BOEM has authorized the use of rock armor at all 130 turbine foundations. The monopiles will be driven through a rock filter layer before installing the rock armor. The rock filter layer will reduce the amount of sediment that would otherwise be re-suspended in the water column as a result of the pile driving.

Prior to either filter or armor stone placement, a multi-beam survey will be performed to create a baseline for quality control of layer thickness/position and for As-Built documentation. Real time surveying of the rock placing work will be performed utilizing multi-beam sonar equipment during placing operations as a quality control measure to ensure the rock is placed in the correct location and thickness. Once the quality control surveys have shown the scour design parameters have been met, a final survey of both the filter and armor layers will be performed to be incorporated as the As-Built documentation.

Other Changes

Other changes to the COP include the change of the connector transitioning the cables from the seabed into the foundation termination point, from a "J-tube" design, to one utilizing a Tekmar cable protection system. The revised COP also incorporates the superseding provisions of the

interim Marking and Lighting Changes issued by the FAA on May 25, 2014, and further provides that the Project will at all times conform to the FAA requirements that are in effect. These revisions will have no effect to Atlantic sturgeon because they involve changes to the project above the water where these species do not occur and effects from them do not extend into the marine environment. Therefore, these revisions are not further assessed in this document.

Atlantic Sturgeon in the Action Area

The marine range of all five DPSs extends from Canada through Florida and includes the action area. Atlantic sturgeon spawn in their natal river and remain in the river until approximately age two and at lengths of approximately 76-92 cm (30-36 inches; ASSRT 2007). After emigration from the natal estuary, subadult and adult Atlantic sturgeon forage within the marine environment, typically in waters less than 50 m in depth, using coastal bays, sounds, and ocean waters (ASSRT 2007). The nearest known spawning rivers to the action area are the Kennebec River (Maine) and the Hudson River (New York). Because of the distance from the nearest known spawning grounds and the salinity of the action area, no eggs, larvae or juvenile Atlantic sturgeon occur in the action area. Only subadult or adult Atlantic sturgeon could be present in the action area.

No part of the action area is a known aggregation, foraging or overwintering area for Atlantic sturgeon. Atlantic sturgeon could be moving through the action area while traveling between spawning, overwintering and foraging areas. There are very few recorded instances of Atlantic sturgeon in the action area. While there have been no targeted studies of Atlantic sturgeon in the action area, there are several longterm fisheries surveys that occur in the general vicinity. The University of Rhode Island's Graduate School of Oceanography Fish Trawl Survey operates in Narragansett Bay and has been ongoing since 1959. A single 30-minute tow is taken at each of two sites (Fox Island and Whale Rock) once per week, year round. In over 5,700 tows, only two Atlantic sturgeon have ever been captured, one in 1963 and one in 1965 (USFWS 2013). The State of Rhode Island also carries out a seasonal fishery assessment in Rhode Island and Block Island Sound with a bottom trawl. Over 3,000 tows have been carried out since 1997 and only one Atlantic sturgeon has been captured (see NMFS 2013 and 2014). The Massachusetts coastal bottom trawl survey has occurred annually in May and September since 1978 and includes sampling sites in Nantucket Sound. There have been no captures of Atlantic sturgeon in Nantucket Sound (NMFS 2013). We also reviewed Massachusetts Department of Marine Fisheries catch data and NMFS landings data for Nantucket Sound going back to 1990. While landing of Atlantic sturgeon was prohibited by the Atlantic States Marine Fisheries Commission in their 1998 moratorium and subsequently by NMFS in federal waters, there was no reported capture or landing of Atlantic sturgeon between 1990 and 1999 (MMS 2009). We have also reviewed sturgeon capture records recorded in the Northeast Fisheries Observer Program and the At Sea Monitoring program (1989-2013). There are nine recorded captures of Atlantic sturgeon in Statistical Area 538 (total records in database are 2,562) which overlaps with the majority of the action area (although it is larger than the action area) and includes all of Nantucket Sound (NMFS unpublished data). Two of the nine captures were within Nantucket Sound; the other seven captures were 5-7 miles west of Cuttyhunk, MA in Rhode Island Sound, an area that may be transited by project vessels.

Based on the best available information summarized above, if any Atlantic sturgeon are present in the action area during the construction, operation, and decommissioning of the Cape Wind project, we would expect very few of them to be there. As noted above, no part of the action area is a known foraging, overwintering area or high use area for Atlantic sturgeon, so any fish in these areas are likely to be occasional transients. Because we do not expect overwintering sturgeon in the action area, we would expect sturgeon to transit through part of the action area only between April and November, if at all.

Effects of the Action

Background Information on Noise and Sturgeon

Sturgeon rely primarily on particle motion to detect sounds (Lovell *et al.* 2005). While there are no data both in terms of hearing sensitivity and structure of the auditory system for Atlantic sturgeon, there are data for the closely related lake sturgeon (Lovell *et al.* 2005; Meyer *et al.* 2010), which for the purpose of considering acoustic impacts can be considered as a surrogate for Atlantic sturgeon. The available data suggest that lake sturgeon can hear sounds from below 100 Hz to 800 Hz (Lovell *et al.* 2005; Meyer *et al.* 2010). However, since these two studies examined responses of the ear and did not examine whether fish would behaviorally respond to sounds detected by the ear, it is hard to determine thresholds for hearing (that is, the lowest sound levels that an animal can hear at a particular frequency) using information from these studies. The best available information indicates that Atlantic sturgeon are not capable of hearing noise in frequencies above 1000 Hz (1 kHz) (Popper 2005). Sturgeon are categorized as hearing “generalists” or “non-specialists” (Popper 2005). These species do not have specializations to enhance their hearing capabilities. One such specialization is coupling between the swim bladder and the inner ear. Sturgeon do not have this coupling, which makes these species less sensitive to sound than hearing specialists. Low-frequency impulsive energies, including pile driving, can affect fish with swim bladders by causing vibrations of the swim bladder sufficient to cause damage to tissues and organs as well as to the swim bladder (Halvorsen *et al.* 2012). Sturgeon have a physostomous (open) swim bladder meaning there is a connection between the swim bladder and the gut (Halvorsen *et al.* 2012). Fish with physostomous swim bladders, including Atlantic sturgeon, are thought to be able to expel air with the result being diminished tension on the swim bladder and a reduction in damaging effects during exposure to impulsive sounds. Fish with physostomous swim bladders are expected to be less susceptible to injury from exposure to impulsive sounds, such as pile driving, than fish with physoclistous swim bladders (Halvorsen *et al.* 2012).

If a noise is within a fish’s hearing range and is loud enough to be detected, effects can range from mortality to a minor change in behavior (e.g., startle), with the severity of effects increasing with the loudness and duration of the noise (Hastings and Popper 2005). The actual nature of effects, and the distance from the source at which they could be experienced will vary and depend on a large number of factors, such as fish hearing sensitivity, source level, how the sounds propagate away from the source and the resultant sound level at the fish, whether the fish stays in the vicinity of the source, the motivation level of the fish, etc.

Criteria for Assessing the Potential for Physiological Effects to Sturgeon

The Fisheries Hydroacoustic Working Group (FHWG) was formed in 2004 and consists of biologists from NMFS, USFWS, FHWA, and the California, Washington and Oregon DOTs, supported by national experts on sound propagation activities that affect fish and wildlife species of concern. In June 2008, the agencies signed a Memorandum of Agreement documenting criteria for assessing physiological effects of pile driving on fish. The criteria were developed for the acoustic levels at which physiological effects to fish could be expected. It should be noted, that these are onset of physiological effects (Stadler and Woodbury 2009), and not levels at which fish are necessarily mortally damaged. These criteria were developed to apply to all species, including listed green sturgeon, which are biologically similar to Atlantic sturgeon and for these purposes can be considered a surrogate. The interim criteria are:

- Peak SPL: 206 decibels relative to 1 micro-Pascal (dB re 1 μ Pa) (206 dB_{Peak}).
- cSEL: 187 decibels relative to 1 micro-Pascal-squared second (dB re 1 μ Pa²-s) for fishes above 2 grams (0.07 ounces) (187 dBcSEL).
- cSEL: 183 dB re 1 μ Pa²-s for fishes below 2 grams (0.07 ounces) (183 dBcSEL).

At this time, these criteria represent the best available information on the thresholds at which physiological effects to sturgeon from exposure to impulsive noise such as pile driving, are likely to occur. It is important to note that physiological effects may range from minor injuries from which individuals are anticipated to completely recover with no impact to fitness to significant injuries that will lead to death. The severity of injury is related to the distance from the pile being installed and the duration of exposure. The closer the fish is to the source and the greater the duration of the exposure, the higher likelihood of significant injury.

Since the FHWG criteria were published, two papers relevant to assessing the effects of pile driving noise on fish have been published. Halvorsen *et al.* (2011) documented effects of pile driving sounds (recorded by actual pile driving operations) under simulated free-field acoustic conditions where fish could be exposed to signals that were precisely controlled in terms of number of strikes, strike intensity, and other parameters. The study used Chinook salmon and determined that onset of physiological effects that have the potential of reduced fitness, and thus a potential effect on survival, started at above 210 dB re 1 μ Pa²-s cSEL. Smaller injuries, such as ruptured capillaries near the fins, which the authors noted were not expected to impact fitness, occurred at lower noise levels. Chinook salmon are hearing generalists with a physostomous swim bladder. Results from Halvorsen *et al.*, (2012a) suggest that the overall response to noise between chinook salmon and lake sturgeon is similar.

Halvorsen *et al.* (2012b) exposed lake sturgeon to pile driving noise in a laboratory setting. Lake sturgeon were exposed to a series of trials beginning with a cSEL of 216 dB re 1 μ Pa²-s (derived from 960 pile strikes and 186 dB re 1 μ Pa²s ssSEL). Following testing, fish were euthanized and examined for external and internal signs of barotrauma. None of the lake sturgeon died as a result of noise exposure. Lake sturgeon exhibited no external injuries in any of the treatments but internal examination revealed injuries consisting of haematomas on the swim bladder, kidney and intestines (characterized by the authors as “moderate” injuries) and partially deflated swim bladders (characterized by the authors as “minor” injuries). The author concludes that an appropriate cSEL criteria for injury is 207 dB re 1 μ Pa²s.

It is important to note that both Halvorsen papers (2012a, 2012b) used a response weighted index (RWI) to categorize injuries as mild, moderate or mortal. Mild injuries (RWI 1) were determined by the authors to be non-life threatening. The authors made their recommendations for noise exposure thresholds at the RWI 2 level and used the mean RWI level for different exposures. Because we consider even mild injuries to be physiological effects and we are concerned about the potential starting point for physiological effects and not the mean, for the purposes of this consultation we will use the FHWG criteria to assess the potential physiological effects of noise on Atlantic sturgeon and not the criteria recommended by Halvorsen *et al.* (2012a, 2012b). Therefore, we will consider the potential for physiological effects upon exposure to impulsive noise of 206 dB_{Peak} and 187 dBcSEL. Use of the 183 dBcSEL threshold is not appropriate for this consultation because all Atlantic sturgeon in the action area will be larger than 2 grams. As explained here, physiological effects from noise exposure can range from minor injuries that a fish is expected to completely recover from with no impairment to survival to major injuries that increase the potential for mortality, or result in death.

Available Information for Assessing Behavioral Effects on Sturgeon

To date, neither NMFS nor the FHWG have published criteria for underwater noise levels resulting in behavioral responses. However, in practice, we rely on a level of 150 dB re 1uPa RMS as a conservative indicator as to when a behavioral response can be expected in fish exposed to impulsive noise such as pile driving. This level is based on the available literature where fish behavior has been observed (see for example Fewtrell 2003 and Mueller-Blenkle *et al.* 2010). Because there are no published studies establishing the noise levels at which sturgeon respond behaviorally to noise, these studies of fish which are likely more sensitive to noise than Atlantic sturgeon are a reasonable conservative indicator of when sturgeon can be expected to respond behaviorally to noise.

Fewtrell (2003) exposed caged fish to air gun arrays. Fewtrell (2003) reported altered behavioral responses (alarm responses, faster swimming speeds) for fish exposed to noise of 158-163 dB re 1uPa. Consistent startle responses were observed at noise levels of 167-181 dB re 1uPa (in striped trumpeters). Alarm responses became more frequent at noise levels above 170 dB re 1uPa. Fewtrell reports that avoidance behavior is expected at noise levels lower than that required to produce a startle response.

Mueller-Blenkle *et al.* (2010) played back pile-driving noise to cod and sole held in two large net pens. Movements of fish were tracked and received sound pressure levels were measured. The authors noted a significant movement response to the pile-driving stimulus in both species at received SPL of 144-156 dB re 1uPa peak (cod) and 140-161 dB re 1uPa peak (sole). Indications of directional movements away from the sound source were noted in both species. We are aware of only one study that has attempted to assess the behavioral responses of sturgeon to underwater noise.

A monitoring plan is currently being implemented at the Tappan Zee Bridge replacement project (Hudson River, New York) using acoustic telemetry receivers to examine the behavior of acoustically tagged sturgeon. During the installation of test piles, the movements of tagged Atlantic sturgeon were monitored with a series of acoustic receivers. Tagged Atlantic sturgeon

spent significantly less time in the detection area (an area that encompassed the 206 dB re 1 μ Pa peak, 187 dB re 1 μ Pa 2s cSEL and 150 dB re 1 μ Pa RMS SPL isopleths), during active impact pile driving compared to that time period just prior to the work window. Results of this study indicate that sturgeon are likely to avoid areas with potentially injurious levels of noise (AKRF and Popper (2012a, 2012b). However, due to limitations of the study design, it is not possible to establish the threshold noise level that results in behavioral modification or avoidance of Atlantic sturgeon. Monitoring is ongoing as the bridge project progresses. To date, hundreds of tagged sturgeon have been documented in the project area; however, no sturgeon have been injured or killed as a result of exposure to pile driving noise.

For the purposes of this analysis, we will use 150 dB re 1 μ Pa RMS as a conservative indicator of the noise level at which there is the potential for behavioral effects, provided the operational frequency of the source falls within the hearing range of the species of concern. That is not to say that exposure to noise levels of 150 dB re 1 μ Pa RMS will always result in behavioral modifications or that any behavioral modifications will rise to the level of “take” (i.e., harm or harassment) but that there is a potential, upon exposure to noise at this level, to experience some behavioral response. We expect that behavioral responses could range from a temporary startle to avoidance of the area with disturbing levels of sound. The effect of any anticipated response on individuals will be considered in the effects analysis below.

Pile Driving

Sound levels associated with the driving of the monopiles that will support the wind turbines have been modeled and results are presented in Table 1. Modeling indicates that the source level of the noise (dB re 1 μ Pa at 1 meter) with the required single bubble curtain will be 241 dB re 1 μ Pa peak with a spectral energy of 1 Hz to 20 kHz for the impact hammer and 220 dB re 1 μ Pa peak for the vibratory hammer. A vibratory hammer may be used for boulder mitigation. Only one pile will be installed at a time, with each pile needing 4-6 hours of pile driving at a rate of 2-36 strikes per minute. Table 1 considers noise produced during the installation of the 5.1-5.5 m diameter monopiles that will support the 130 WTGs. Modeling has not been carried out for installation of the 8 42” piles that will support the ESPs. However, because underwater noise is directly related to pile diameter (i.e., larger diameter steel piles will be louder than smaller diameter steel piles when installed in the same area with the same equipment; Illingworth and Rodkin 2007), these results represent an extreme worst case for the 8 42” piles, which are about 20% the diameter of the monopiles.

As noted above, we expect potential injury to Atlantic sturgeon upon exposure to pile driving noises greater than 206 dB re 1 μ Pa peak or 187 dB re 1 μ Pa cSEL. Modeling results indicate that the 206 dB re 1 μ Pa peak isopleth will have a radius no larger than 22 meters. Therefore, to experience noise loud enough to cause injury with just a single exposure (i.e., one strike of the hammer), a sturgeon would need to be within 22 meters of the pile being driven. There are several factors that make exposure to injurious levels of noise extremely unlikely to occur. First, if Atlantic sturgeon are present in the action area, they would be there only in very low numbers, making the likelihood of their occurrence in any particular area low at best. Further, even if a sturgeon was very close to the pile installation site, all pile driving operations will be initiated with a “soft” start or a system of “warning” strikes that are designed to create enough noise to cause fish to leave the area prior to full energy pile driving; that is, the impact hammer will be

operated at 40 percent of its total energy, which will result in the production of underwater noise levels at or above 150 dB_{RMS} (within seconds of the initiation of pile driving operations), but below 206 dB_{Peak}. That is, the noise levels will be below those likely to result in injury (206 dB peak) but above those likely to result in a sturgeon swimming away from the noise source (150 dB re 1uPa RMS). At this energy level, warning strikes will consist of a set of 3 strikes on the pile, followed by a one minute waiting period; this will be performed two subsequent times. As described above, sturgeon are expected to respond behaviorally, via avoidance, upon exposure to bothersome levels of noise (greater than 150 dB re 1uPa RMS; see below for further assessment of behavioral effects). As a result, we expect any sturgeon close to the piles when pile driving begins, will detect the warning strikes and begin to move away from the noise source. This expectation is consistent with the results reported by AKRF and Popper (2012) during pile installation for the Tappan Zee Bridge. Because the soft-start will take 3-5 minutes, we expect sturgeon to move more than 22 meters from the pile and therefore, never be exposed to a single strike peak noise of 206 dB re 1uPa.

In addition to the “peak” exposure criteria, which relates to the energy received from a single pile strike, the potential for injury exists for multiple exposures to lesser noise. That is, even if an individual fish is far enough from the source to not be injured during a single pile strike, the potential exists for the fish to be exposed to enough smaller-impact strikes to result in physiological impacts. The cSEL criterion is used to measure such cumulative impacts. The cSEL is not an instantaneous maximum noise level, but is a measure of the accumulated energy over a specific period of time (e.g., the period of time it takes to install a specific structure, such as a pile). For the proposed action, it will take 4-6 hours to install each pile, with only one pile being driven per day. The cSEL is calculated by incorporating both the noise level associated with a single strike of the pile as well as the total number of pile strikes. Because the cSEL accounts for all of the strikes necessary to install a pile, we must consider if it is reasonably likely that a sturgeon will be exposed not to a single pile strike but the number of pile strikes used for the calculation. In this case, because it will take 4-6 hours of driving to install each pile, a sturgeon would only be exposed to noise at 187 dB re 1uPa 2s cSEL if it remained within 795m of the pile being installed for the entire duration of pile driving (modeled at 5 hours). It is extremely unlikely that a sturgeon would remain within this distance of the pile being driven for the entire pile driving period. From the initiation to the completion of pile driving, disturbing levels of underwater noise will be produced within seconds of each strike of the pile and thus, well before any energy is accumulated to a level in which injury may occur. As described above, a soft start will be undertaken prior to the initiation of pile driving at full energy, and thus, will result in underwater noise levels (150 dB_{RMS}) that will result in the movement of Atlantic sturgeon away from the pile being installed. As each strike of the pile intensifies, the extent at which the 150 dB_{RMS} will be experienced will also increase; that is at full energy, underwater noise levels of 150 dB_{RMS} will be experienced at a distance of 2.5 km from the source. Thus, sturgeon that left the area during the initiation of pile driving will continue to divert their movements away from the sound source as pile driving operations continue and the area of behaviorally disturbing levels of noise increases. As a result, any sturgeon that may have been present at the onset of pile driving operations is not expected to be found within 2.5 km of the pile, and thus, are not expected to remain within the area long enough to accumulate injurious pressure levels.

As explained above, in order to be exposed to pile driving noise of 187 dB re 1 μ Pa 2s cSEL, a sturgeon would need to remain within 795 meters of the pile for the entire duration of pile driving. Once a sturgeon is further than 795 meters from the pile there is no potential for exposure to injurious levels of sound. We expect sturgeon to start swimming away from the pile as soon as pile driving begins. We have considered whether a sturgeon is likely to be able to swim far enough away from the pile being installed in time to avoid exposure to the full duration of pile installation. In order to avoid being exposed to injurious levels of noise, a sturgeon adjacent to a pile at the onset of installation, it would need to swim 795 m before the end of a 5 hour pile driving time, requiring a swim speed of approximately 0.159 km/hour (4.4 cm/s or 0.14 ft/s).

Swimming speeds of fish are generally classified as sustained, prolonged, or burst. Sustained speeds are low and those which the fish can maintain for long periods (i.e., >200 min). They depend on aerobic metabolism, do not result in muscular fatigue, and are used in foraging and other routine activities. Prolonged speeds are moderate, of intermediate duration (i.e., 0.5–200 min), and use aerobic and anaerobic metabolism. Burst speeds are the highest attainable speeds, but can only be maintained for short periods (i.e., <0.5 min) due to accumulation of anaerobic metabolites and muscular fatigue (Peake 2004 in LeBreton *et al.* 2004). Higher prolonged and burst speeds are used in prey capture, short-term movements in fast current, and predator avoidance and, consequently, can be used to characterize ‘escape’ speeds. We would expect sturgeon swimming away from a loud noise (such as a pile being installed with an impact hammer) to start out at “burst” or “escape” speed and then slow down to “prolonged” or “sustained” speed when its burst speed duration had been exceeded. Maximum swim speed for sturgeon can be described as a linear function of fish length; given that, larger fish are expected to be capable of swimming faster than smaller fish (Peake 2004). Any sturgeon in the action area are expected to be at least 76 cm (the expected minimum size of Atlantic sturgeon migrating outside of their natal estuary; ASSRT 2007). Given the morphological similarities between all sturgeon species, it is reasonable to use other sturgeon species as a surrogate for establishing swim speed of Atlantic sturgeon.

A study examining daily non-migratory movements of subadult and adult green sturgeon (101–153 cm TL) in San Francisco Bay (Kelly and Klimley 2011) reports an average swimming speed of 0.5–0.6 meters/second (1.6–2 fps) with a maximum recorded speed of 2.1 meters/second (7 fps). Reported burst (also called critical or maximum) swim speeds of subadult and adult shovelnose, lake, and green sturgeon range from 60–116 cm/s (1.9–3.8 fps) (Cheong *et al.* 2006). Sustained swim speeds of adult lake sturgeon were reported as 83.7 cm/s (2.74 fps) (Cheong *et al.* 2006).

Hoover *et al.* (2011) demonstrated the swimming performance of juvenile lake sturgeon and pallid sturgeon (12 – 17.3 cm FL) in laboratory evaluations. The authors compared swimming behaviors and abilities in water velocities ranging from 10 to 90 cm/second (0.33–3.0 fps). They report burst swim speeds of 40–70 cm/s (1.3–2.3 fps), prolonged swimming at 15–70 cm/s (0.5–1.5 fps) and sustained swimming at speeds of 10–45 cm/s (0.3–1.5 fps). Boysen and Hoover (2009) assessed the probability of entrainment of juvenile white sturgeon by evaluating swimming performance of young of the year fish (8–10 cm TL). The authors report escape speeds of 40–45 cm/s. Kieffer *et al.* (2009) reports maximum swim speeds of juvenile shortnose sturgeon (14–

18cm) as 3.4 cm/s (or 2.18 body lengths/second). Clarke (2011) reports on swim tunnel performance tests conducted on juvenile and subadult Atlantic, white and lake sturgeon. He concludes that burst swim speed is approximately 65 cm/s (2.1 fps) and prolonged swim speed is 45 cm/s (1.5 fps). We expect the Atlantic sturgeon in the action area to have greater swim speeds than the juveniles studied due to their significantly larger size.

Assuming that the sturgeon in the action area have a swimming ability at least equal to those subadults reported in studies summarized above, we expect all Atlantic sturgeon in the action area to have a prolonged swim speed of at least 1.5 fps (45 cm/s) and an escape or burst speed of at least 2.1 fps (64 cm/s). Sturgeon are expected to be able sustain their prolonged swim speed for up to 200 minutes without muscle fatigue and their sustained swim speed for periods longer than 200 minutes. To move away from a pile being installed in sufficient time to avoid accumulating enough energy to result in injury, a sturgeon would need to be swimming at 0.14 fps for a maximum period of 5 hours. This is far less than the minimum prolonged swim speed reported for subadult sturgeon (1.5 fps). At a prolonged swim speed of 1.5 fps, a sturgeon would be able to swim outside the area where potentially injurious levels of noise could be experienced (795 m) in less than 30 minutes. Therefore, we expect all sturgeon in the action area to be able to readily swim away from the ensonified area at a normal sustained swim speed in time to avoid injury. Based on this analysis, we do not expect any Atlantic sturgeon to be exposed to noise resulting from impact pile driving that could result in physiological effects including injury or mortality.

As described above, Atlantic sturgeon are expected to react behaviorally to underwater noise levels of 150 dB_{RMS} by demonstrating avoidance behaviors. Underwater noise levels of 150dB_{RMS} will extend a maximum of 2.5 km from the pile being driven. Any sturgeon within 2.5 km of the pile being driven are expected to swim away from the noise until they are outside the area where noise is louder than 150dB RMS. Any sturgeon outside of the area where noise is louder than 150 dB RMS would avoid the area with elevated noise until the pile driving stops. As noted above, pile driving will occur for no more than 6 hours per day. Very few Atlantic sturgeon are likely to be present in the area where noise will be elevated above 150 dB RMS (i.e., within Nantucket Sound).

The effect of avoiding this area for up to a 6-hour period is expected to be insignificant given that if the area is used at all it would only be used for occasional transient movements between other areas. Avoiding the ensonified area would not result in any negative impacts to any Atlantic sturgeon. Sturgeon that make evasive movements to avoid the area with disturbing levels of noise may experience increased energy expenditure and a delay of resting and foraging. However, due to the temporary nature of the disturbance (i.e., 6 hours a day), and the transient nature of any individuals in the action area, an individual Atlantic sturgeon would only experience this disturbance once. Because a sturgeon will be able to “escape” from the noisy area at normal, sustained or prolonged swim speeds, any increased metabolic cost is expected to be insignificant and will not cause any physiological stress to the fish. Based on this analysis, all effects to Atlantic sturgeon from avoidance behavior will be insignificant and/or discountable.

Clamshell Dredge

Peak noise of the clamshell dredge will be 163 dB re 1uPa; it is below the levels that could result in injury to Atlantic sturgeon. Noise associated with the clamshell dredge will attenuate to below 150 dB within 50 meters of the pile where the dredge is being used. It is extremely unlikely that an Atlantic sturgeon would be within 50 meters of any pile where the clamshell dredge is used. However, even if a sturgeon was present, it would be expected to leave the area where noise is greater than 150 dB. Swimming at a normal swim speed of 1.5 fps, a sturgeon would be able to leave the noisy area in less than 2 minutes. Avoiding the ensonified area would not result in any negative impacts to any Atlantic sturgeon. Sturgeon that make evasive movements to avoid the area with disturbing levels of noise may experience increased energy expenditure and a delay of resting and foraging. However, due to the extremely limited time it would take to swim away from the increased noise (less than 2 minutes) and the very short distance the fish would need to travel (less than 50 meters), any increased metabolic cost is expected to be insignificant and will not cause any measurable physiological stress to the fish. Based on this analysis, any effects to Atlantic sturgeon from avoidance behavior will be insignificant and/or discountable. Because the clamshell dredge will only be operated within the monopile, no Atlantic sturgeon will be exposed to any other effects of use of the clamshell dredge.

Drilling

BOEM reports expected noise levels during drilling of 127 dB re 1uPa (see Table 1). Noise levels that could result in injury (i.e., greater than 206 dB re 1uPa peak or 187 dB re 1uPa_{2s} cSEL) or may elicit a behavioral response (i.e., greater than 150 dB re 1uPa RMS) will not be generated during drilling. Therefore, any Atlantic sturgeon exposed to underwater noise associated with drilling would not be affected. Because the drill will only be operated within the monopile, no Atlantic sturgeon will be exposed to any other effects of use of the drill.

Multibeam surveys

A multi-channel multi-beam depth sounder will be used to make inspections associated with scour protection. The equipment operates at frequencies between 200-400 kHz (ESS 2012). The multi-beam depth sounder operates at a frequency well above the hearing abilities of sturgeon (less than 1000 Hz; Lovell *et al.* 2005; Meyer *et al.* 2010). Therefore, any Atlantic sturgeon exposed to underwater noise associated with drilling would not be affected.

Noise of Project Vessels

Noise levels that may elicit a behavioral response (i.e., greater than 150 dB re 1uPa RMS) will only be experienced within several meters of the project related vessels. Given the rarity of Atlantic sturgeon in the action area, we do not expect Atlantic sturgeon to be that close to any project vessel; therefore, we do not anticipate any behavioral disturbance from noise associated with the operations of the project vessels.

Operation of WTGs

The noise producing components of the WTG are at the nacelle, hundreds of feet above the water surface. Underwater noise is expected to be only slightly elevated above ambient noise levels (109.1 dB and 107.2 dB, respectively) and is well below noise levels that may cause a behavioral response. Because of this, there will be no effects to any Atlantic sturgeon.

Interactions with the Cable Laying Operations

Jet plows move along the benthos at slow speeds (i.e., < 1 knot). As sturgeon are highly mobile, any sturgeon that may be present at or near the benthos will be able to move out of the way of the device, thereby avoiding an interaction. Although any sturgeon present in the vicinity of the jet plow may be displaced, displacement would be temporary (i.e., for the duration of the jet pass; no more than a few minutes) and will only result in a temporary shift in swimming direction away from the area affected by the jet plow for up to several minutes. This displacement will not affect the ability of the individual to complete any essential life functions (i.e., opportunistic foraging, resting, migrating) that may take place along the cable route as any animals that may have moved from the affected area will be able to continue normal life functions in other nearby unaffected areas and will also be able to resume these behaviors once the jet plow has passed. Additionally, as the cable will be taut as it is unrolled and laid in the trench, there is no risk of entanglement. Based on this information, we believe that it is extremely unlikely that any sturgeon will interact with cable laying and jetting equipment and thus, believe that any effects of the use of this equipment are discountable.

Electromagnetic Field

The inner-array and submarine cable is a dielectric AC cable, consisting of a core of 3-phase conductors encased by grounded metallic (i.e., lead) shielding that effectively blocks any electric field generated by the operating cabling system.

Research on EMF also indicates that although high sensitivity has been demonstrated by certain species (especially sharks) for weak electric fields, this sensitivity is limited to steady and slowly-varying fields (Cape Wind Tech Report; ICNIRP 2010; Adai 1994; Valberg *et al.* 1997 in MMS 2009; Normandeau *et al.* 2011). The proposed action produces 60-Hz time-varying fields and no steady or slowly-varying fields. Likewise, evidence exists for marine organisms utilizing the geomagnetic field for orientation, but again, these responses are limited to steady and slowly-varying fields. 60-Hz alternating power-line EMF fields, such as those generated by the proposed action, have not been reported to disrupt marine organism behavior, orientation, or migration. Based on the body of scientific evidence, there are no anticipated adverse impacts from the undersea power transmission cables or other components of the proposed action on the behavior, orientation, or navigation of marine organisms, including Atlantic sturgeon, or their prey species. Based on this and the best available information, any effects of the magnetic fields associated with the operation of the cable systems are insignificant and discountable.

The burial depth of the cables also minimizes potential thermal impacts from operation of the cable system. No thermal impacts to Atlantic sturgeon are anticipated.

Project Related Vessels

The factors relevant to determining the risk to Atlantic sturgeon from vessel strikes may be related to size and speed of the vessels, navigational clearance (i.e., depth of water and draft of the vessel) in the area where the vessel is operating, and the behavior of Atlantic sturgeon in the area (e.g., foraging, migrating, etc.) (Brown and Murphy 2010). It is important to note that while vessel strikes may occur in other rivers, they have been identified as a significant concern only in the upper Delaware and James rivers and current thinking suggests that there may be unique geographic features in these areas (e.g., potentially narrow migration corridors combined with

shallow/narrow river channels) that increase the risk of interactions between vessels and Atlantic sturgeon. There are no documented vessel strikes in the ocean or in the action area. The risk of vessel strikes between Atlantic sturgeon and vessels operating in the action area is likely to be very low given that the vessels are operating in an open water environment and there are no restrictions forcing Atlantic sturgeon into close proximity with the vessel as may be present in some rivers. We also expect Atlantic sturgeon in the action area, if any, to be at or near the bottom. Given the depths in the action area and the draft of project vessels, interactions between project vessels and fish at or near the bottom are extremely unlikely. Based on these factors, an Atlantic sturgeon strike due to the increase in vessel traffic is discountable.

Destruction of Prey Resources/Loss of Foraging Habitat

Activities that disturb the sea floor will also affect benthic communities, and can cause effects to Atlantic sturgeon by reducing the numbers or altering the composition of the species upon which Atlantic sturgeon prey. Activities that may affect the sea floor and result in the loss of foraging resources for listed species include:

- Cable installation;
- WTG and ESP installation;
- Scour protection (scour mats and rock armoring).

Loss of Benthic Resources/Habitat

The proposed action will result in both the temporary disturbance and permanent loss of benthic habitat. Effects to benthic resources and habitat will be restricted to the area within the project footprint and along the cable route where sediment disturbing activities will occur. Atlantic sturgeon in the marine environment feed on benthic invertebrates and small fish, such as sand lance. However, given the use of the action area by only a small number of transient individuals, any foraging is expected to be very limited if it occurs at all.

The installation of the submarine transmission and inner-array cables will result in temporary impacts to approximately 866 acres (less than 6% of the action area). This accounts for the 4-6 foot wide trench that will be jetted along the 12.5 mile submarine transmission cable and the 70 miles of inner-array cables. The jetting process will affect benthic resources and habitat in two ways: entrainment of microorganisms and displacement or burial of other benthic resources. Some mobile organisms (such as fish) are expected to move away from the disturbance; however, in general, we anticipate a temporary loss of benthic invertebrates along the cable route. Impacts associated with cable installation, barge positioning, anchoring, anchor line sweep, and the pontoon on the jet plow device would be temporary and localized. Impacts from anchor line sweep would primarily affect the sediments to a depth of between 3 and 6 inches. Anchoring locations would have disturbances to the sediment to a depth of 4 to 6 feet at each anchor deployment, leaving a temporary irregularity to the seafloor with localized mortality of infauna. Jet plow embedment would directly disturb sediments to a depth of approximately 8 feet.

Modeling was presented by BOEM in the DEIS which estimated seabed scar recovery from jet plow cable burial operations. Using the assumption that 3 percent of the sediments in the jetted cross section could be injected back into the water column and that the coarse sediment column is returned to the trench, it was estimated that the dimensions of the scar left along the cable

routes would be 6 feet wide and from 0.75 to 1.7 feet deep. BOEM also estimated approximate recovery times for the trench scars. Based on bedload transport rates for Horseshoe Shoal and throughout Nantucket Sound, recovery rates for jetting scars along the cable route are estimated to be between 0.2 and 38 days. Recovery of jetting scars on Horseshoe Shoal is anticipated to occur within a few days. It is likely that seabed scars from cable burial in Lewis Bay, MA (where the cable will make landfall) would last months or until a major storm occurs.

Egg and larval stages of demersal species would experience some mortality due to burial. The temporary displacement of benthic habitats is also likely to result in the mortality and/or dispersal of other benthic organism in the footprint of the construction activities. As the jetting and cable laying occurs very slowly, most mobile organisms (i.e., crabs, finfish) are likely to be able to avoid the area where the jet plow is operating. The cable route has been designed to avoid eel grass beds in Lewis Bay. There are very limited areas of submerged aquatic vegetation (SAV), mostly macroalgae as opposed to sea grass that will be affected by construction on Horseshoe Shoal.

The alteration of benthic habitat and the loss of benthic resources during construction could reduce the amount of potential forage for Atlantic sturgeon, albeit by an extremely small amount. However, most mobile organisms, including most Atlantic sturgeon prey items, are likely to be able to avoid the jetting. Recolonization of temporarily disturbed areas is expected to be rapid, with colonization by mobile organisms beginning within days and complete recolonization occurring within 3-12 months. As cable laying will occur over several months and recovery of benthic communities will take another several months, foraging opportunities along the cable route may be reduced for one to two years. However, as only a small percentage of Nantucket Sound will be affected, any impacts to Atlantic sturgeon foraging opportunistically in the area will be limited to movements to areas where benthic invertebrates were not disturbed adjacent to the jet plow path. Given the narrow corridor to be affected, these movements would be small and localized.

The installation of the WTG monopiles and the ESP will result in the permanent loss of 0.67 acres of benthic habitat (less than 0.0042% of the project area). Although these impacts would result in permanent loss of 0.67 acres of bottom that may support benthic invertebrates, the areas impacted are not contiguous and impacts to any Atlantic sturgeon foraging in the area will be limited to movements to areas not impacted. These limited movements to nearby areas will not have a detectable effect on Atlantic sturgeon.

Habitat Shift

The presence of 130 monopile foundations, 8 ESP piles and their associated scour control mats in Nantucket Sound has the potential to shift the area immediately surrounding each monopile from soft sediment, open water habitat to a structure-oriented system. This may create localized changes, namely the establishment of "fouling communities" within the area and an increased availability of shelter among the monopiles. The WTG monopile foundations will represent a source of new substrate with vertical orientation in an area that has a limited amount of such habitat, and as such may attract finfish and benthic organisms. Although the monopile foundations would create additional attachment sites for benthic organisms that require fixed (non-sand) substrates and additional structure that may attract certain finfish species, the

additional amount of surface area being introduced (approximately 1,200 square feet (111 square meters) per tower, assuming an average water depth of 30 feet (9.1m) below mean high water (MHW)) would be a minor addition to the hard substrate that is already present. Due to the small amount of additional surface area in relation to the total area of the proposed action and Nantucket Sound and the spacing between WTGs (0.34 to 0.54 nautical miles (0.63 to 1.0 km) apart), the new additional structure is not expected to alter the species composition in the action area. While the increase in structure and localized alteration of species distribution in the action area around the WTG monopiles may affect the localized movements of Atlantic sturgeon in the action area and provide additional foraging opportunities in the action area for these species, any effects will be beneficial or insignificant.

Water Quality Degradation and Increased Marine Debris

Increased Turbidity and Exposure to Contaminated Sediments

Increased turbidity and resuspension of sediments can be expected from the following activities:

- Cable installation;
- WTG and ESP pile installation; and,
- Vessel anchoring.

Of these activities, cable installation, including jetting and backfill, is expected to generate the most turbidity and disturbance of bottom sediments. Simulations of sediment transport and deposition from jet plow embedment of the submarine cable system and inner array cables were performed and reported in BOEM's BA and DEIS and explained in the 2010 Opinion. The model results demonstrate that concentrations of suspended sediment in the water column resulting from the jet plow embedment operations are largely below 50mg/L in Nantucket Sound. The modeling results indicate that the suspended sediment concentration levels are short lived due to the tides flushing the plume away from the jetting equipment and the sediments rapidly settling out of the water column. For example, the duration of time when suspended sediment levels will be greater than 10mg/L above background levels is less than 3 hours after the jet plow has passed a given point along the route. In places along and immediately adjacent to the cable route, suspended sediment concentrations are predicted to remain at 100mg/L for 2-3 hours.

In Lewis Bay (where the cable will make landfall), suspended sediments are predicted to remain in suspension considerably longer than in Nantucket Sound due to weak tidal currents. Modeling demonstrates that the concentration of suspended sediment in the water column resulting from jet plow operations in Lewis Bay will be below 500mg/L. Suspended sediment concentrations in excess of 100mg/L are generally predicted to remain for less than 2 hours with the exception of some sections along the route where durations may be as long as 6 hours. Suspended sediment concentrations in excess of 10mg/L above background are generally predicted to remain for less than 24 hours after the jet plow has passed a given point, with the exception of the area near the Yarmouth landfall where concentrations in excess of 10mg/L are predicated to remain for up to 2 days after the jet plow passes as a result of very weak currents and fine bottom sediments.

Studies of the effects of turbid waters on fish suggest that concentrations of suspended solids can reach thousands of milligrams per liter before an acute toxic reaction is expected (Burton 1993). The studies reviewed by Burton demonstrated lethal effects to fish at concentrations of 580mg/L to 700,000mg/L depending on species. Sublethal effects have been observed at substantially lower turbidity levels. For example, prey consumption was significantly lower for striped bass larvae tested at concentrations of 200 and 500 mg/L compared to larvae exposed to 0 and 75 mg/L (Breitburg 1988 in Burton 1993). Studies with striped bass adults showed that pre-spawners did not avoid concentrations of 954 to 1,920 mg/L to reach spawning sites (Summerfelt and Moiser 1976 and Combs 1979 in Burton 1993). The Normandeau 2001 report identified five species in the Kennebec River for which TSS toxicity information was available. The most sensitive species reported was the four spine stickleback which demonstrated less than 1% mortality after exposure to TSS levels of 100mg/L for 24 hours. Striped bass showed some adverse blood chemistry effects after 8 hours of exposure to TSS levels of 336mg/L. While there have been no directed studies on the effects of TSS on shortnose or Atlantic sturgeon, shortnose and Atlantic sturgeon juveniles and adults are often documented in turbid water and Dadswell *et al.* (1984) reports that shortnose sturgeon are more active under lowered light conditions, such as those in turbid waters. Cech and Doroshov (2004) report that sturgeon generally prefer dimly lit, moderately turbid water. As such, Atlantic sturgeon are assumed to be at least as tolerant to suspended sediment as other estuarine fish such as striped bass.

The life stages of sturgeon most vulnerable to increased sediment are eggs and larvae which are subject to burial and suffocation. As noted above, no eggs and/or larvae will be present in the action area. Sturgeon are frequently found in turbid water and would be capable of avoiding any sediment plume by swimming higher in the water column. Laboratory studies (Niklitschek 2001 and Secor and Niklitschek 2001) have demonstrated shortnose sturgeon are able to actively avoid areas with unfavorable water quality conditions and that they will seek out more favorable conditions when available. TSS is most likely to affect subadult or adult Atlantic sturgeon if a plume causes a barrier to normal behaviors or if sediment settles on the bottom affecting their benthic prey. Because any increase in suspended sediment is minor and temporary, it will not affect the movement of individual sturgeon. Even if the movements of sturgeon were affected, these changes would be small. As sturgeon are highly mobile any effect on their movements or behavior will be insignificant. Additionally, the TSS levels expected are below those shown to have an adverse effect on fish (580.0 mg/L for the most sensitive species, with 1,000.0 mg/L more typical; see summary of scientific literature in Burton 1993) and benthic communities (390.0 mg/L (EPA 1986)); therefore, effects to benthic resources that sturgeon may eat are extremely unlikely. Based on this information, any effects of increased suspended sediment and turbidity will be insignificant.

Contaminants

BOEM has reported that analysis of sediment core samples obtained from the area of the proposed action indicate that sediment contaminant levels were below established thresholds in reference Effect Range-Low and Effects-Range-Median marine sediment quality guidelines. Therefore, the temporary and localized disturbance of these sediments during the proposed action's construction activities are not anticipated to result in increased contaminants in lower trophic levels. Therefore, Atlantic sturgeon are not likely to experience increased bioaccumulation of chemical contaminants in their tissues from the consumption of prey items in

the vicinity of the proposed action, and any effects to whales or sea turtles from the disturbance of these sediments will be discountable. Since other sources of turbidity and seafloor disturbance (i.e., pile installation and scour protection placement) will be minimal compared to that caused by cable installation, the overall effect of project construction on Atlantic sturgeon due to turbidity and exposure to contaminants is insignificant or discountable.

Increased Marine Debris

Personnel will be present onboard the barges throughout construction activities, thus presenting some potential for accidental releases of debris overboard. Discharge of debris overboard by vessel personnel will be prohibited, and violations will be subject to enforcement actions. As a result, construction activities are not expected to result in increased marine debris. Therefore, effects to Atlantic sturgeon are discountable are not anticipated. Even if some garbage does enter the water, effects to sturgeon are discountable given sturgeon feed on bottom dwelling invertebrates and small fish and are extremely unlikely to ingest pieces of garbage.

Decommissioning

At the conclusion of the life of the Cape Wind project, components would be retrieved and removed from the site. All components in the water column would be retrieved, including the ESP, WTGs, and submarine cables. At the end of the proposed action's lifespan, removal of the WTG monopile foundations and ESP piles at the time of decommissioning would result in a localized shift from a structure-oriented habitat near the WTGs and ESP to the original shoal-oriented habitat present prior to construction to the proposed action. However, as the addition of the monopiles would be a minor addition to the hard substrate that was present prior to the construction of the WTG facility, the removal of the WTGs and ESPs will not cause a great impact in the overall habitat structure. Therefore, the number of Atlantic sturgeon in the action area will not increase due solely to the presence of the monopiles (and an associated increase in colonizing benthic invertebrate prey) and hence would not be adversely affected by their removal.

These removal activities are expected to have impacts similar to those discussed above in relation to construction activities. However, all impacts would be of less magnitude than those resulting from construction activities. As such, any effects of decommissioning activities will be insignificant or discountable.

Non-routine and Accidental Events

Cable Repair

Many of the types of disturbances that would occur during cable repair activities are smaller and of shorter duration, but of similar type, to those that would occur during cable installation. A relatively short distance along the sea floor would be disturbed by the jetting process used to uncover the cable and allow it to be cut so that the cable ends could be retrieved to the surface. In addition to the temporary loss of some benthic organisms, there would be increased turbidity for a short period, and a localized increase in disturbance due to vessel activity, including noise and anchor cable placement and retrieval. As explained in the cable installation sections above, any effects of the cable laying process, and similarly, the cable repairing process, would be insignificant or discountable.

Vessel Collision with Monopile

Effects, if any, to Atlantic sturgeon from a vessel collision with a monopile would be limited to the effects of vessel or monopile parts that enter the water and of the effects of any repair activities. Given the low risk of vessel collision with a monopile and the scarcity of Atlantic sturgeon in the area, any effects are insignificant or discountable.

Oil Spill

As noted in the 2010 Opinion, oil spills could occur either as a release from the ESP storage tank or from a vessel collision with a monopile. An oil spill would be an unintended, unpredictable event. Marine animals, including sturgeon, could be negatively impacted by exposure to oil and other petroleum products. Without an estimate of the amount of oil released it is difficult to predict the likely effects on listed species. CWA is required to develop an oil spill response plan which would ensure rapid response to any spill. As the effects of a spill are likely to be localized and temporary as well as extremely unlikely to occur, Atlantic sturgeon are extremely unlikely to be exposed to oil. Any effects are therefore discountable. Additionally, should a response be required by the US EPA or the USCG, there would be an opportunity for NMFS to conduct a consultation with the lead Federal agency on the oil spill response, which would allow NMFS to consider the effects of any oil spill response on listed species in the action area in light of the specific situation at the time.

Air Emissions from Project Vessels Operating on the OCS

In the 2010 Opinion, we noted that any effects to air quality from the proposed action are likely to be insignificant. As in 2010, there is no information on the effects of air quality on listed species that may occur in the action area, including Atlantic sturgeon. However, as the emissions regulated by EPA will have insignificant effects on air quality, it is reasonable to conclude that any effects to Atlantic sturgeon from these emissions will also be insignificant.

Conclusions Regarding Atlantic Sturgeon

We have determined that any and all effects to the Atlantic sturgeon will be insignificant and/or discountable. Accordingly, we concur with your determination that the proposed action is not likely to adversely affect any DPS of Atlantic sturgeon, individually or collectively. No incidental take of Atlantic sturgeon is anticipated or exempted. Take is defined in the ESA as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct.” If there is any incidental take of Atlantic sturgeon, reinitiation of consultation will be required.

Loggerhead Sea Turtle


As you know, the 2010 Opinion considered the effects of the Cape Wind project on the loggerhead sea turtle as listed globally; however, on September 22, 2011, we published a final rule (76 FR 58868), replacing the global listing of the loggerhead with nine loggerhead DPSs distributed globally: (1) North Pacific Ocean DPS, (2) South Pacific Ocean DPS, (3) North Indian Ocean DPS, (4) Southeast Indo-Pacific Ocean DPS, (5) Southwest Indian Ocean DPS, (6) Northwest Atlantic Ocean DPS, (7) Northeast Atlantic Ocean DPS, (8) Mediterranean Sea DPS, and (9) South Atlantic Ocean DPS. In a November 22, 2011 memorandum, we previously

concluded that the effects analysis and jeopardy analysis included in the 2010 Opinion remains valid for the Northwest Atlantic DPS. That memo is enclosed here for your reference.

As you also know, critical habitat was designated for the Northwest Atlantic DPS of loggerhead sea turtles on July 10, 2014 (79 FR 39856). Several areas off of the U.S. Atlantic coast were designated as critical habitat; however, none of these areas extend further north than 37.84°N latitude. The Cape Wind action area does not overlap with any of the areas designated as critical habitat for the Northwest Atlantic DPS of loggerheads. Therefore, as stated in the 2010 Opinion, there is no designated critical habitat in the action area and none will be affected by the construction, operation or decommissioning of the Cape Wind project. Our conclusions are consistent with the determination regarding loggerhead critical habitat in your September 2014 assessment accompanying your letter.

We look forward to continuing to work with your office as the Cape Wind project moves forward. For further information regarding any consultation requirements, please contact Julie Crocker of my staff at (978)282-8480 or by e-mail (Julie.Crocker@noaa.gov).

Sincerely,



John K. Bullard
Regional Administrator

for

Enclosure

Ec: Boelke – F/NER4
USACE
EPA
DOE

File Code: Sec 7 BOEM Cape Wind
PCTS: NER-2010-3866

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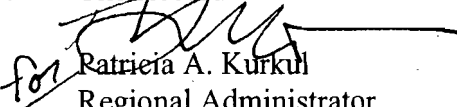
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ENCLOSURE TO 12/23/2014 NMFS LETTER



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
55 Great Republic Drive
Gloucester, MA 01930-2276

NOV 14 2011

MEMORANDUM FOR: The Record
FROM: 
Patricia A. Kurkul
Regional Administrator

SUBJECT: Consideration of Final Rule for Loggerhead Sea Turtles
and our Biological Opinion for the Cape Wind project

NOAA Fisheries Service (NMFS) has previously completed formal section 7 consultation with the Bureau of Ocean Energy Management (BOEM¹) on the proposed Cape Wind energy project. We most recently issued a Biological Opinion to BOEM on December 30, 2010. The 2010 Opinion replaced an Opinion signed on November 18, 2008.

The recent ESA listing of nine Distinct Population Segments (DPS) of loggerhead sea turtles (*Caretta caretta*) has prompted a consideration of the 2010 Opinion in light of the change in the listing of loggerheads. The final rule, which went into effect on October 24, 2011, replaces the global listing of loggerheads by listing nine loggerhead DPSs distributed globally: (1) North Pacific Ocean DPS, (2) South Pacific Ocean DPS, (3) North Indian Ocean DPS, (4) Southeast Indo-Pacific Ocean DPS, (5) Southwest Indian Ocean DPS, (6) Northwest Atlantic Ocean DPS, (7) Northeast Atlantic Ocean DPS, (8) Mediterranean Sea DPS, and (9) South Atlantic Ocean DPS (76 FR 58868). The 2010 Opinion considers effects of the Cape Wind project on loggerhead sea turtles as listed globally. However, for the reasons described below, the effects analysis and jeopardy analysis included in these Opinions remains valid for the Northwest Atlantic DPS.

We have considered the available information on the distribution of sea turtles that originate from the 9 DPSs to determine the origin of any loggerhead sea turtles that may occur in the action area. Previous literature (Bowen *et al.* 2004) has suggested that there is the potential, albeit small, for some juveniles from the Mediterranean DPS to be present in U.S. Atlantic coastal foraging grounds. These conclusions must be interpreted with caution however, as they may be representing a shared common haplotype and lack of representative sampling at Eastern Atlantic rookeries rather than an actual presence of Mediterranean DPS turtles in US Atlantic coastal waters. A re-analysis of the data by the Atlantic loggerhead Turtle Expert Working Group has found that it is unlikely that U.S. fishing fleets are interacting with either the Northeast Atlantic loggerhead DPS or the Mediterranean loggerhead DPS (Peter Dutton, NMFS, Marine Turtle Genetics Program, Program Leader, personal communication, September 10, 2011). Given that the action area is a subset of the area fished by US fleets, it is reasonable to assume that based on

¹ BOEM was the lead Federal agency for consultation. The Opinion also considered effects of authorizations proposed by the Army Corps of Engineers and the Environmental Protection Agency.



this new analysis, no individuals from the Mediterranean DPS or Northeast Atlantic DPS would be present in the action area. Sea turtles of the South Atlantic DPS do not inhabit New England waters (Conant *et al.* 2009). As such, all loggerheads likely to be present in the action area for the Cape Wind consultation will have originated from the Northwest Atlantic DPS.

The effects analysis in the 2010 Opinion determined that a certain number of loggerhead sea turtles would be exposed to increased underwater noise during pre-construction surveys and during pile driving. The ITS exempted a certain level of take of loggerhead sea turtles by harassment. No injury or mortality is anticipated and none was exempted by the ITS.

The analysis in the 2010 Opinion considered the effect of this harassment on loggerheads originating from the western North Atlantic. The Opinion concluded that there would be no reduction in numbers, reproduction or distribution of loggerheads in the western North Atlantic. In the 2010 Opinion, we considered whether the proposed action would jeopardize the continued existence of the Northwest Atlantic DPS. In a section of the Opinion titled, "Proposed Rule to List Loggerhead Sea Turtles," we stated, "as the proposed action will not result in the injury or mortality of any loggerhead sea turtles, it is reasonable to expect that the conclusions reached for the Northwest Atlantic population and current range-wide listing would be the same as for the proposed Northwest Atlantic DPS."

There is no new information on the effects of the proposed action or any new information on loggerheads that change the determination reached in the 2010 Opinion. As such, we have determined that the conclusions reached in the 2010 Opinion remain valid for the Northwest Atlantic DPS. As such, it is not necessary to produce a new Biological Opinion to consider effects of the continued operation of this action on the Northwest Atlantic DPS. We have also determined that the incidental take statement (ITS) provided with the 2010 Opinion remains valid and will serve to exempt incidental take of loggerheads originating from the Northwest Atlantic DPS.

EC: Crocker – F/NER3
Collins – GCNE

File Code: Sec 7 BOEM Cape Wind
PCTS: F/NER/2010/03866